PROCEEDINGS

OF

THE ROYAL SOCIETY.

January 6, 1887.

Professor STOKES, D.C.L., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "On the Occurrence of Silver in Volcanic Ash from the Eruption of Cotopaxi of July 22nd and 23rd, 1885." By J. W. MALLET, M.D., F.R.S., University of Virginia. Received November 26, 1886.

A few months ago I received from Señor Julian R. Santos, of Ecuador, formerly a pupil of mine in the laboratory of this University, a specimen of volcanic ash collected at his place of residence, Bahia de Caraguez, on the coast of the Pacific, about 120 miles nearly due west from Cotopaxi. This, the highest and among the most mighty of the active volcanoes of our globe, burst forth into eruption about $11\frac{1}{2}$ P.M. on the 22nd of July, 1885, and the ash began to fall at Bahia de Caraguez at 7 A.M. on the next day, the 23rd. It fell there to the depth of several inches, this fact alone indicating the discharge of an enormous amount of solid matter into the atmosphere, although Señor Santos wrote to me that the unsettled condition of the country, disturbed by revolutionary movements, prevented his making extended enquiries which might have ascertained the area covered by the fall of ashes.

The specimen sent me consisted of a very finely divided powder, mobile and soft to the touch, of light brownish-grey colour. Under the microscope it appeared to be made up of minute granules and spicules, in general with sharp, more or less splintery edges. These were for the most part colourless and transparent, or white and translucent; some were reddish, some dark bottle-green, some brown, some black and opaque. Most of those clear enough to freely transmit light showed brilliant colours in a field of polarised light. Quartz, two felspars (one white, and one pink or reddish), augite, magnetite

(strongly attracted, and easily removed by the end of a magnetic needle), and thin scales of deep red specular iron oxide were easily distinguished.

The ash on being strongly heated before the blowpipe, or even in considerable quantity in a small platinum crucible over the blast lamp, turned dark red-brown, and fused to a nearly black slag.

On being boiled in its original state with water it gave up 0·21 per cent. of soluble matter. The solution gave very distinctly the reactions of chlorine, a sulphate, and sodium; in a less marked degree the reactions of potassium. On boiling with strong hydrochloric acid, 6·94 per cent. was dissolved, in addition to that already extracted by water; the acid solution was deeply coloured by iron.

The specific gravity of the ash was found = 2·624 at 18° C. as compared with water at the same temperature.

An analysis of the material taken as a whole, *i.e.*, without any previous mechanical separation of its consistent minerals, and without previous digestion with water or acid, but dried at 100° C., gave the following results:—

SiO_2	56·89
TiO_2	trace
Al_2O_3	19·72
Fe_2O_3	4·06
FeO	3·65
MnO	trace
MgO	1·91
CaO	5·87
Na_2O	5·14
K_2O	1·96
Li_2O	trace
Ag	,,
Cl	,,
SO_4	,,
PO_4	,,
H_2O	0·62
	99·82

Silver was first noticed after fusing as usual with mixed sodium and potassium carbonates, and dissolving in excess of hydrochloric acid, on the addition of sulphuretted hydrogen to the solution, which had been freed from silica; the sulphur thrown down by ferric chloride present was observed to be distinctly brown, and on being filtered out and carefully burned off before the blowpipe it left a minute bead of metallic silver. All the reagents and vessels used were scrupulously examined, but the silver could not be traced to any of them. It was

afterwards found that the metal could be obtained from the ash by furnace assay—fusion with pure lead carbonate, sodium carbonate, and a little cream of tartar, and cupellation of the lead button produced; and a comparative experiment was made, with negative result, using larger quantities of the same reagents, but omitting the volcanic ash.

It was ascertained that silver could be extracted from the ash by boiling it with a solution of ammonia, or of potassium cyanide, or of sodium thiosulphate, but the metal was not dissolved out in appreciable amount on boiling with nitric acid. Hence, as seems most probable, it was present in the ash as silver chloride. The fact of its being found in the solution in hydrochloric acid of the mass resulting from fusion with the alkaline carbonates, is of course easily explained by the solvent action upon silver chloride of the chlorides of sodium and potassium, and (when such minute quantities are concerned) of hydrochloric acid itself.

The discovery of silver in the ash in question adds for the first time this metal to the list of elementary substances observed in the materials ejected from volcanoes, and the addition derives some special interest from the fact of the ash having come from the greatest of the volcanic vents of the great argentiferous chain of the Andes.

Lead, which was found by Señor Santos himself, when a student here in 1879, in a specimen of ash from the eruption of Cotopaxi of August 23rd, 1878,* was sought for in the ash now reported upon, but neither it nor any other heavy metal beside silver was detectable.

Several concordant experiments proved that the silver was present to the extent of about 1 part in 83,600 of the ash, or about two-fifths of a Troy ounce per ton of 2240 pounds. Small as is this proportion, it must represent a very large quantity of silver ejected during the eruption, in view of the vast masses of volcanic ash which must have been spread over such an area as is indicated by the fall at so distant a point as Bahia de Caraguez.

II. "Preliminary Note on the Continuity of the Liquid and Gaseous States of Matter." By WILLIAM RAMSAY, Ph.D., and SYDNEY YOUNG, D.Sc. Communicated by Prof. G. G. STOKES, D.C.L., P.R.S. Received November 30, 1886.

For several years past we have been engaged in an examination of the behaviour of liquids and gases through wide ranges of temperature and pressure. The results of our experiments with ethyl alcohol have recently been published in the 'Philosophical Transactions;' those with acetic acid in the 'Journal (Transactions) of the Chemical Society'; and the Royal Society have in their hands a

* 'Chem. News,' Oct. 17, 1879 (vol. 40, p. 186).